"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Power System)"

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BATTERY CHARGER WITH ALARM APPLICATION

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DEDICATIONS

To all my family members and also to all my friends who helped me when doing this project

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ABSTRACT

Unlike any other battery charger, this project is about the combination of battery charger circuit with alarm circuit. The main objective of this project is the alarm will send signal to the user. Thus, the user will know that the batteries are already fully charged. It consists of 3 segments, the power supply, charging circuit and alarm circuit. In this project, the charging process is focus more on AA batteries. The heart of the circuit located at LM324. It is the segment that controlling the charging process of the whole circuit. 2 pins are required. First pin (pin 12) is for Upper Limit Set, while the second pin (pin 9) is for lower limit set. This both pin sending the signal as a reference value. The upper limit send an information that the batteries is overcharged while the lower limit send the information about batteries deep discharge. Both of them are controlled by a potentiometer. When this is happen, the LM324 will send signal to the transistor. This transistor than operates thus energizes the relay coil. When the relay retracted, the charging process is halt and at the same time, operates the buzzer. The buzzer will continue to ring until the charger is turn off.

ABSTRAK

Tidak seperti pengecas bateri yg lain, projek ini adalah kombinasi antara litar pengecas bateri dan litar amaran. Objektif utama projek ini adalah untuk menghasilkan bunyi amaran kepada pengguna. Sekaligus, menyedarkan pengguna bahawa batteri yg sedang dicas sudah dicas sepenuhnya. Terbahagi kepada 3 bahagian, Pembekal Kuasa, Litar Pengecas dan Litar penggera. Dalam projek ini, proses cas ditumpukan kepada bateri jenis AA NiCd. Lokasi utamanya terletak di bahagian LM324. Inilah bahagian yang mengawal proses cas seluruh litar. 2 kaki LM diperlukan. Kaki pertama (kaki 12), adalah untuk Had atas. Sementara kaki kedua (kaki 9), adalah untuk Had bawah. Kedua-dua pin ini menghantar isyarat sebagai isyarat rujukan. Had Atas mengahantar isyarat tentang lebihancas bateri, sementara had bawah menghantar isyarat lebihan nyahcas bateri. Kedua-duanya dikawal oleh Perintang Boleh Laras. Apabila ini berlaku, LM324 akan menghantar isyarat ke transistor. Transistor akan berfungsi sekaligus akan mengoperasikan gelungan relay. Apabila relay berfungsi, proses cas akan berhenti serta-merta. Dan, buzzer akan berbunyi sehingga suis ditutup.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, battery charger has been widely used. With the advancement of the technology, most electrical appliances have now been adapted to use rechargeable batteries. This has been proved to be more economical and environmental friendly. The most obvious example is the 12V Car Batteries.

In this project, it's focused more to develop battery charger systems for small appliances, for examples, the AA batteries. The main contribution of this project is how the charger circuit can actually send enough current supply to the batteries so that the charger process can take place. Also, the aim of this project also to developed a new application for the current battery charger so that it can produce a better breed in the future.

1.2 Objectives

The objectives of the project:

i. To develop a battery charger equipped with alarm/buzzer that can give signal to user when the charging is completed
ii. To charge two AA NiCd, 1.2V from no charge state to it's fully operation state.
iii. To operates a buzzer when the voltage reach more than 3,0 V.

1.3 Scope of Project

There are two scope of the project, to develop a charger circuit and to develop a buzzer circuit/system. The charger circuit is to develop to charge a battery. The battery used in this project is an AA NiCd Battery, 700 mAh. The buzzer circuit function is to give signal to users. It is equipped to the circuit. The buzzer used is 5V buzzer.

1.4 Problem Statement

Among the main problem while develop the system are:

i. Firstly, the current charger circuit equipped with alarm circuit is a rare breed. It is very hard to find and also not widely used.

ii. Second, most of the current voltage tracing circuit was used to check a circuit for a low voltage. It is clearly not suitable for used in the system as it require circuit that can trace a high voltage (battery voltage during its full load)

1.5 Thesis Organization

Including this chapter, it consist of 5 chapters altogether. Chapter 1 is a brief introduction about the project. Chapter 2 is contained full description of the project, Chapter 3 is consisting of the project methodology, mostly about the project flow and how it’s organized. Chapter 4 is for presenting the expected result, while the conclusions are presented in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Charging Circuit

2.1.1 Battery Charger

A battery charger is a device used to put energy into a secondary cell or (rechargeable) battery by forcing an electric current through it. The charge current depends upon the technology and capacity of the battery being charged. For example, the current that should be applied to recharge a 12 V car battery will be very different from the current for a mobile phone battery

2.1.2 Types of Battery Charger

There are several types of battery charger which are namely simple, trickles, time-based, intelligent, fast, pulse, inductive and USB based. Each of this type is required in its own specifications.

A simple charger works by connecting a constant DC power source to the battery being charged. The simple charger does not alter its output based on time or the charge on the battery. This simplicity means that a simple charger is inexpensive, but there is a tradeoff in quality. Typically, a simple charger takes longer to charge a battery to prevent severe over-charging. Even so, a battery left in a simple charger for too long will be weakened or destroyed due to over-charging. These chargers can supply either a constant voltage or a constant current to the battery.

A trickle charger is a kind of simple charger that charges the battery slowly, at the self-discharge rate. A trickle charger is the slowest kind of battery charger. A battery can be left in a trickle charger indefinitely. Leaving a battery in a trickle charger keeps the battery "topped up" but never over-charges. Trickle charging, also called float charging, means charging a battery at a similar rate as it is self-discharging, thus maintaining a full capacity battery. Most rechargeable batteries, particularly nickel-cadmium batteries or nickel metal hydride batteries, have a moderate rate of self-discharge, meaning they gradually lose their charge even if they are not used in a device. One must be careful, however, that if a battery regulator is not employed, the charge rate isn't greater than the level of self-discharge, or overcharging and possible damage or leakage may occur. For example, a 24 volt battery pack, comprising 12 2-volt flooded lead-acid cells, which has been deeply discharged, would normally be restored by a boost charge of approximately 2.4 volts per cell for a short time (perhaps around 72 hours). Once the collective cell voltage reaches a surface charge of 28.8 volts (2.4 volts x 12 cells), the charge rate would be switched to the sustained lower float-charging rate of typically 2.23 volts.

Eventually, with the Boost charge removed, the surface charge will diminish slightly and the battery-bank voltage will stabilise at a preset float voltage, in the case of the example above to approximately 27 volts (2.23 volts x 12). Charging rates for a trickle charge are very low. For example, if the normal capacity of a battery is C (ampere-hours), the battery may be designed to be discharged at a rate of C/8 or an 8-hour rate. The recharge rate may be at the C/8 rate or as fast as C/2 for some types of battery. A float or trickle charge might be as low as C/300 (a 300-hour discharge rate) to overcome the self-discharge. Allowable trickle charging rates must conform to the battery manufacturer's recommendations. In low duty-cycle applications, where a relatively high current or power is required infrequently, charger costs can be minimized by applying trickle-charging principles. This can be an economy measure in cases where the charging method could be quite expensive if the full charging rate were employed, such as solar-cell installations. Full battery capacity can be achieved at a low charging current over a long period of time to provide a high-power load for a short period.

The output of a timer charger is terminated after a pre-determined time. Timer chargers were the most common type for high-capacity Ni-Cd cells in the late 1990s for example (low-capacity consumer Ni-Cd cells were typically charged with a simple charger). Often a timer charger and set of batteries could be bought as a bundle and the charger time was set to suit those batteries. If batteries of lower capacity were charged then they would be overcharged, and if batteries of higher capacity were charged they would be only partly charged. With the trend for battery technology to increase capacity year on year, an old timer charger would only partly charge the newer batteries. Timer based chargers also had the drawback that charging batteries that were not fully discharged, even if those batteries were of the correct capacity for the particular timed charger, would result in over-charging.

Output current depends upon the battery's state. An intelligent charger may monitor the battery's voltage, temperature and/or time under charge to determine the optimum charge current at that instant. Charging is terminated when a combination of the voltage, temperature and/or time indicates that the battery is fully charged. For Ni-Cd and NiMH batteries, the voltage across the battery increases slowly during the charging process, until the battery is fully charged. After that, the voltage *decreases*, which indicates to an intelligent charger that the battery is fully charged. Such chargers are often labeled as a ΔV, or "delta-V," charger, indicating that they monitor the voltage change. However, the magnitude of "delta-V" can become small or even nonexistant if (very) high capacity rechargable batteries are recharged. This can cause even an intelligent battey charger to not sense that the batteries are actually already fully charged, and continue charging. Overcharging of the batteries result. A typical intelligent charger fast-charges a battery up to about 85% of its maximum capacity in less than an hour, then switches to trickle charging, which takes several hours to top off the battery to its full capacity.

Fast chargers make use of control circuitry in the batteries being charged to rapidly charge the batteries without damaging the cells' elements. Most such chargers have a cooling fan to help keep the temperature of the cells under control. Most are also capable of acting as a standard overnight charger if used with standard NiMH cells that do not have the special control circuitry. Some fast chargers, such as those made by Energizer, can fast-charge any NiMH battery even if it does not have the control circuit.

Inductive battery chargers use electromagnetic induction to charge batteries. A charging station sends electromagnetic energy through inductive coupling to an electrical device, which stores the energy in the batteries. This is achieved without the need for metal contacts between the charger and the battery. It is commonly used in electric toothbrushes and other devices used in bathrooms. Because there are no open electrical contacts, there is no risk of electrocution.

Since the Universal Serial Bus specification provides for a five-volt power supply, it's possible to use a USB cable as a power source for recharging batteries. Products based on this approach include chargers designed to charge standard NiMH cells, and custom NiMH batteries with built-in USB plugs and circuitry which eliminate the need for a separate charger. Moixa Energy patented a design of batteries, branded USBCELL, that incorporate their own USB chargers internally, complete with their own plugs. In the currently available AA battery design, the positive end of the battery doubles as a flip-cap for the built-in USB plug.

2.1.3 Charge rate

The charge rate of battery charger is often denoted as *C* and signifies a charge or discharge rate equal to the capacity of a battery divided by 1 hour. For example *C* for a 1600 mAh battery would be 1600 mA (or 1.6 amps). 2*C* is twice this rate and 1/2*C* is half the rate.

2.1.4 Applications

The battery charger mainly is used widely in 3 categories, as a mobile phone charger, Battery charger for vehicles, and Battery electric vehicle.

Most mobile phone chargers are not really chargers, only adapters that provide a power source for the charging circuitry which is almost always contained within the mobile phone. Mobile phones can usually accept relatively wide range of voltages' as long as it is sufficiently above the phone battery's voltage. However, if the voltage is too high, it can damage the phone. Mostly, the voltage is 5 volts or slightly higher, but it can sometimes vary up to 12 volts when the power source is not loaded. Battery chargers for mobile phones and other devices are notable in that they come in a wide variety of DC connector-styles and voltages, most of which are not compatible with other manufactuers' phones or even different models of phones from a single manufacturer. Users of publicly accessible charging kiosks must be able to cross-reference connectors with device brands/models and individual charge parameters and thus ensure delivery of the correct charge for their mobile device. A database-driven system is one solution, and is being incorporated into some of the latest designs of charging kiosks.

The Ionhub charger can simultaneously charge several electronic devices: iPod Nano, Razr, Nintendo DS Lite, BlackBerry, portable DVD player, and electric shaver.

There are also human-powered chargers sold on the market, which typically consists of a dynamo powered by a hand crank and extension cords. There are also solar chargers.

China and other countries are making a national standard on mobile phone chargers using the USB standard.

2.2 Battery Definition

Battery or voltaic cell is a combination of one or more electrochemical Galvanic cells which store chemical energy that can be converted into electric potential energy, creating electricity. Since the invention of the first Voltaic pile in 1800 by Alessandro Volta, the battery has become a common power source for many household and industrial applications, and a multi-billion dollar industry. The name "battery" was coined by Benjamin Franklin for an arrangement of multiple Leyden jars (an early type of capacitor) after a battery of cannons. Common usage has evolved to include a single electrical cell in the definition [1]

2.2.1 AA Battery

AA Battery is a dry cell-type battery commonly used in portable electronic devices. The AA battery type was standardized by ANSI in 1947, and is designated E91 by DIN and AM3 by JIS. Internationally the IEC designated it as LR6 (alkaline), R6 (carbon-zinc), KR157/51 (nickel-cadium), HR6 (nickel-metal-hydride), and FR6 (lithium-iron-disulfide). Other names include MN1500 and HP7. In France it's known colloquially as Mignon. An AA battery is composed of a single electrochemical cell.

2.2.2 Rechargeable AA Battery

The capacity of rechargeable AA batteries varies with the technology used. Nickel-cadmium (NiCd or NiCad) AAs with a capacity of 650 to 800 mAh are commonly available, while 800 to 1100 mAh AA types are rarer and more expensive. Nickel-metal hydride (NiMH) AAs are also available in various capacities ranging from 1300 to 2900 mAh.

AA rechargeable batteries supply 1.2 Volts, and as such, there can be problems powering some devices. For instance, a device powered by 4 AA batteries uses 6 Volts, but when powered from rechargebles the voltage will be 4.8 V, which may not be in the normal operating range. Some devices include warnings not to be used with rechargeable batteries.

The older NiCd battery chemistry can supply a higher current than typical NiMHs, so NiCds are commonly used to power model cars or other relatively high-